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The five-step model – procurement to increase transport efficiency for an urban distribution of goods

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Abstract

The efficiency of a transport system is dependent on how resources in the system are utilized. The freight transport sector in Sweden is fragmented, composed predominantly of small operators affiliated with intermediary companies that handle sales and contact with customers. In addition, the majority of innovations in freight transport have been technical in nature, such as advancements in engines, fuel type and information technology. Organizational developments leading to changed behavior remain lacking. The aim of this paper is to further develop the procurement process with route optimization to improve overall efficiency in a transport system. An unconditional requirement is digital information at all stages in the supply chain. In a case study, a commercial vehicle routing software was used to create a situation analysis of a manually dispatched transport network to 324 retail outlets, which was subsequently compared to the route-optimized solution. Next, the case study was related to a new transport service purchasing model, the "Five-step model". The five steps are outlined, beginning with situation analysis followed by the simulation of new routes; the procurement process, including defining specifications and selecting a provider; open book pricing with joint review of routes; negotiations and contractor agreement; and, finally, payment with reverse billing. In the Five-step model, stakeholders negotiate in terms of distance, time, and sequenced routes, rather than a single price per stop, which is customary in the transport industry in Sweden. Implicitly, the relationship between parties changes, with greater transparency and ultimately a shift in power in the supply chain from the transport company to the transport buyer.

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Keywords: Five-step model; procurement process; route optimization; transport efficiency; urban freight

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1. Introduction

The freight transport sector, with countless senders and receivers of goods employing a variety of vehicles with disparate ownership, constitutes all stakeholders that have an impact on the provided transport services (McKinnon, 2010). The efficiency of the transport system is therefore dependent on the total resources used: business models, vehicles, drivers, information technology, and infrastructure. Changes in the transport system generally take place independently, with little effect on an aggregate level. In this sense, the freight transport sector can be characterized as a "loosely coupled systems", with high complexity, many actors with peer relationships, and decisions managed operatively (Weick, 1976; Dubois & Hulthén, 2014). These companies cannot, for obvious reasons, perceive the entire transport system; instead, they interact around a transport service, but note that they all start from their own business models and strategies (Teece, 2010).

A business model describes a company's external relationships with customers, suppliers and investors but also internal activities related to production, human resources, marketing and business development, in other words, how the company is positioning itself in the market based on strategic decisions by senior management and owners (Zott & Amit, 2006). The freight transport sector lacks a unified business model for transport services with general applicability, where the business model directly or indirectly affects efficiency in the transport system. Instead, interaction takes place between different actors in transport networks, i.e., between business models, interconnecting senders and recipients through direct links or the consolidation of goods in an effort to efficiently utilize transport resources (Voxenius, 2007). However, what is perceived as efficient in business terms on an individual level between buyers and providers can, in a societal context on an aggregate level, be proven ineffective by a low (overall) fill rate, which contributes to a high (overall) negative environmental impact (Santén, 2013).

Collaboration between the sender, transporter and receiver is determined in a procurement process where goods are linked to a specific transport service, which in turn is connected to an existing transport network. Procurement constitutes the interface between the parties involved and the time when key figures, such as margins and profits, are paired with business practices and, implicitly, efficiency in the supply chain (Sandberg, 2007). In the present study, the interface between transport buyers and transport logistics providers is called the "transport service purchasing model", based on a general procurement process of goods whose rudimentary form consists of three phases: defining specifications, selecting a supplier and reaching a contractor agreement (van Weele, 2010).

The aim of this paper is to analyze and evaluate a transport service purchasing model based on route optimization, the “Five-step model”, in terms of long-term (sustainable) economic development for all stakeholders in the transport supply chain. The introduction of new technology in the form of route optimization software requires transparency with digital information at all stages in the supply chain (the mantra of this study). In return, cost savings occur through a decrease in vehicle kilometers of travel (VKT), an increase in the fill rate, an increase in profitability per vehicle, and improvement in delivery performance with added value for the end-customers. The challenge with such a transparent procedure is that the power of the supply chain shifts from the transport company to the transport buyer and alters responsibilities and working practices between actors. In addition, increased transport efficiency inevitably leads to existing assignments becoming redundant because an increased fill rate reduces the resources needed in terms of vehicles and personnel.

The paper is organized as follows. First, an overview of urban freight in Sweden is provided, followed by a review of innovation and business models regarding freight transport. Next, a case study is presented in which route optimization is applied to an existing transport flow for the distribution of goods, accompanied by a situation analysis and a comparison to a simulation of new routes. The results of the case study are then related to the procurement process, and a new transportation service purchasing model, the Five-step model, is defined. The five steps, namely, situation analysis, simulation of new routes, the procurement process, joint review of contracts, and reverse billing, are highlighted. Lastly, some concluding remarks are presented. A procurement process involves two parties, a buyer and a provider; the purchaser is known as the transport buyer throughout the paper, and the counterpart is called the transport company.

2. Urban Freight in Sweden

The freight transport industry in Sweden is fragmented with predominantly small operators, of which 80 percent are single owners with less than two vehicles and scarce administrative resources affiliated with an intermediary company that handles sales and contact with customers (Swedish Association of Road Transport Companies, 2013). Likewise, 80 percent of the overall procurement of road freight transport is channeled through an intermediary company such as freight forwarders, haulage contractors and, in recent years, third-party logistics (3PL) providers (Transport Analysis, 2014). In the procurement process, the transport buyer, as a counterpart, is two legal entities, the owner of the transaction (the intermediary company) and subcontractors (individual transporters), which in turn have agreements among themselves.

Urban freight forms the bulk of goods transported in Sweden. Approximately 80 percent of road transport routes are shorter than 200 kilometers, and a significant proportion consists of roadwork and construction materials (Swedish Association of Road Transport Companies, 2013). Emissions from the freight transport sector accounts for approximately 40 percent of Sweden's total consumption of fossil fuels, which increased between 1990 and 2012. However, when figures are broken down by mode of transportation, notable differences arise. For passenger cars, emissions fell by 14 percent even though traffic increased, which can be attributed to more efficient engines and increased use of biofuels. In contrast, the emissions from freight transport increased by 44 percent during the same period. (Swedish Environmental Protection Agency, 2014: 91)

The main reason that truck shipments have increased and consequently the fill rate has decreased is end-customer demands on delivery performance and “just-in-time”. The trend of increasing fragmentations in transport flows brings losses in economies of scale due to a lack of consolidation of goods (van Duin et al., 2007). This growing fragmentation and focus on customization by transport companies runs counter to improved efficiency in the transport network and a reduced environmental impact (Transport Analysis, 2012).

Sweden has been the driving force in the proposal by the European Commission to reduce emissions of greenhouse gases by 30 percent by 2030. In fact, the Swedish government has expressed that even more vigorous efforts are needed (Swedish Ministry of Enterprise and Innovation, 2014). The relationship between reality and policy forms an equation that will not reach equilibrium until 2030. Swedish authorities’ attitude on both local and national levels has been that market stakeholders should reduce environmental impact through self-regulation, something that has not happened and almost certainly will not take place on a voluntary basis (Moen, 2013).

3. Innovation and Business Models in Freight Transport

There is consensus from government agencies and the scientific community that a large proportion of heavy vehicles could be removed from the road network with more efficient planning that increases the fill rate (Piecyk & McKinnon, 2010; Vierth et al., 2012). However, there are substantial reservations at the system level because there has been no research and development work leading to innovations based on changed behavior in the freight transport sector. What "changed behavior" refers to are measures that increase (transport) efficiency through altering roles and responsibilities, which implies transparency in the business process.

Innovation in the above context has been used to describe new ideas, with the literature distinguishing between technical, organizational and market-driven innovations (Tidd et al., 2001). The majority of innovations in the freight transport sector have been technical in nature: engine power, fuel type, infrastructure projects, new information technology, etc. The goal of this study is to further develop the procurement procedure with route optimization to improve overall efficiency in the transport system, i.e. organizational development leading to changes in behavior.

The investment propensity to develop organizational innovations in the freight transport sector has been low. The relationship is clearly illustrated with an example from KNEG, a network whose members comprise some of the largest transport buyers in Sweden (Ahlbäck, 2012). In terms of the accumulated gains in transport efficiency in 2011, measured as a decrease in CO2, improved engine performance accounted for 54 percent, which can be attributed to ongoing EURO-upgrading of engines. "Greener" (bio) fuels amounted to 38 percent, a substantial share, whereas changes in behavior through new business models accounted for only 6 percent. This last figure is remarkably low considering local, national and pan-European objectives.

There is an abundance of technical innovations that support behavioral change, but no technological progress is better than being put into service, which requires parallel organizational innovation (Brynjolfsson & Mcafee, 2012). Route optimization represents in this context a tool that alters transport service execution and favors transparent behavior (attitude), which requires digital information at all stages of the transport supply chain. Technical improvements will not be enough to achieve the emission reductions required by the EU to achieve global climate goals, both transport buyers and transport companies must change their behavior on how transport assignments are designed (Rogerson et al., 2014). However, there are demands for profitability that must be considered by all stakeholders involved in a transport network. The challenge lies in reducing environmental impact with a new business model that is also innovative and creates a margin or cuts cost, as advocated by environmental capitalism (Hall, 2012).

A business model defines how operations are organized and how the expansion of a company develops. Once a business model is established, there are significant difficulties changing it in a given market segment because it will "cannibalize" customer relations, which depletes sales and profits (Chesbrough, 2010). To incorporate the concept of business models in the current study, the way in which technical innovations, such as route optimization, change contractor agreements, business relationships, responsibilities and the power of transactions in the supply chain is observed (de Figueiredo & Teece, 1996). A new business model requires a new business plan, which cannot be developed based on theory alone; the concept and its economic buoyancy have to be tested over and over before being considered competitive enough to challenge the established way of doing business (Teece, 2009).

In the context of the freight transport sector, the interface between stakeholders must fundamentally change and become more transparent to meet with digital information in all stages of the supply chain. To benchmark, requirements of digital information leading to changed behavior also occur in e-freight markets delivering efficiencies for freight customers (Hassall et al. 2012). However, the question is whether this process will happen organically from within the industry. Based on cross-industry research, the development of new business models does not take place through incumbents, but through smaller companies and startups with higher mobility, which come from the bottom and do not cannibalize existing business relationships (Christensen, 1997; Chesbrough & Rosenbloom; 2002; Teece, 2010).

For the Swedish freight industry, which is divided into separate parts, with transactions occurring through intermediary companies and the providers of the actual transport service, it is unlikely that the change will occur organically. In practice, the transaction level (intermediary companies), with a number of subcontracted vehicles and commitments to obtain assignments, cannot fulfill its contractual obligations to all transport companies in a transparent business model based on route optimization. The intermediary would cannibalize their business, implicitly cannibalizing its own sales. This setting creates a contradiction. Transport assignments vanishing through increased transport efficiency is in line with local, national and supranational (EU) environmental objectives, which aim to use fewer vehicles with reduced VKT and an increased fill rate, thereby reducing undesirable emissions.

In the transport industry, the primary problem has been that complementary technologies have hampered the development of innovation, investment and ultimately new business models. This problem applies particularly to digital information, which is not standard in the transport sector, which, in many cases, relies on manual routines and analog information (Perego et al., 2011). Technological advances such as route optimization are inhibited by a lack of complementary technologies, such as requirements for digital information in all stages of the supply chain, which becomes apparent when the industry is conservative and unwilling to change organically from within (Teece, 2010). Not keeping pace with technological advances in the service sector carries the risk of losing customers to competing companies that have adapted to new business strategies in a competitive marketplace (Chapman et al., 2003).

Why has route optimization not had a significant breakthrough in the transport industry in Sweden, when all research and development work points to (transport) efficiency gains of the order of 25 percent for both static and dynamic routes? Route optimization as a tool has been underestimated in Sweden (Moen, 2010). In particular, there have been doubts from the transport industry, with negative (preconceived) attitudes towards usage and potential earnings (Arvidsson et al., 2013).

One probable explanation can be traced to the question of power over the supply chain. Who will remain in power of transport planning and control? Route optimization creates a transparent output, which also entails a control function of the transport service rendered. A change in the procurement process becomes a strategic issue for transport buyers. In the predominant business model, buyers release themselves from the responsibility of logistics and instead rely entirely on the expertise of the transport company. Thus, and given that transport services themselves are characterized by a (relatively) low level of IT maturity, the transport industry in Sweden has historically had a restrained approach to route optimization as a successful planning tool.

It was not until the 2010s that information technology generated an impact in the freight transport sector, mainly through GPS positioning and mobile communications that generate data and feed a digitized business processes with orders, waybills and vehicle monitoring (Sternberg et al., 2014). However, it is important to note that in most cases, transport planning and the procurement process are not included in the digital information flow. Connectivity by mobile devices does not affect transport efficiency to any significant extent compared to the efficiency gains generated by route optimization (Marchet et al., 2009). Therefore, the above attitude to route optimization from the transport industry is actually a constraint; the results of this and other studies show significant savings in driving time and VKT that can be achieved by replacing manual transport planning by the driver or a dispatcher (Ferrucci, 2013).

4. Case Study of Retail Distribution

Urban freight transport and especially the "last mile" problem constitute primary targets and the types of transport network that can be applied to the presented transport service purchasing model. The empirical part is a case study based on route optimization for a static transport flow emanating from a transport buyer's warehouse. The distribution is carried out with predefined sequencing of delivery addresses. The software used for route optimization is Winroute, a commercial software package based on Vehicle Routing Problem (VRP) algorithms (Winroute, 2012). The first mathematical modeling with VRP-algorithms was published in 1959 by Dantzig & Ramser (1959). Since then, a number of variants of the VRP family have been designed as extensions to the mathematical core of the VR-problem (Golden et al., 2010). The extensions consist of terms and conditions of how the simulations will be executed. Algorithms included in WinRoute are primarily intended for distribution and emphasizs extensions for load optimization using vehicle capacity (CVRP) and route optimization using time windows (VRPTW).

The question may be asked whether the case study has general applicability. Alternatively, does the case study represent a unique situation tailor made for the transport buyer that provided the information? Route optimization is a general tool with usability across a range of industries, with freight transport serving as a part of a supply chain. The primary limiting factor for the use of route optimization is the requirement of digital information in all stages of the supply chain, which is not the case of the transport industry today (Marchet et al., 2009). However, the situation will change rapidly in the future with the development of "Big data" and new, more sophisticated methods of data capture.

Route optimization will be expanded from static routes emanating from a terminal or from the transport buyers own warehouse (the situation in the case study) to dynamic routes that change every day and, further up the road, overlaid transport networks, hubs and spokes with the consolidation of many transport buyer goods. This evolution applies to both vertical integration, i.e., between buyers and providers and the objective in this study, and horizontal cooperation. Collaboration horizontally occurs when transport purchasers and logistics service providers integrate their transport flows based on competition-neutral conditions to increase efficiency between stakeholders at the same level in parallel supply chains (Cruijssen et al., 2007). Research has shown that the fill rate in terms of horizontal cooperation can be further increased through route optimization (vehicle routing), fully consistent with the results in this study (Verdonck et al., 2013.

The aim of the case study was to conduct a situation analysis and simulations with route optimization, with a distribution to 324 retail outlets from a warehouse. The situation analysis was based on the business model "free delivery", where suppliers send large amounts of goods to a wholesaler for storage, consolidation and outbound delivery. The distribution was carried out with static driving routes with demands for an arrival time to stores based on a transport instruction produced with manual dispatching and maintained by the procured transport company. As a counterpart, the wholesaler had a freight forwarder, which in turn was dependent on subcontractors (individual transporters) as transport service providers. Under the above conditions, the aim was to analyze the below addressed issues:

- How efficient was planning in the situation analysis? What time and distance were required to complete the distribution according to the initial transport instruction?
- How much more efficient does planning become with route optimization? How does the transport instruction compare with a planning based on route optimization?

- How should a transport purchasing model be designed based on route optimization? What does a transparent procurement procedure imply when applied to the case study?

Vehicle routing algorithms require accurate input data with delivery volumes and vehicle capabilities, a prerequisite for optimizing the fill rate of each individual vehicle. These input data were available in the case study and were the primary reason for selecting the chosen transport flow. The number of load carriers was reported (type and volume) and converted, with an average calculation down to a decimal of a pallet location (PAL). The vehicles used were 16-ton trucks with a capacity of 18 PAL, and the time window of distribution was weekdays 09:00-17:00. The distribution vehicles were equipped with on-board computers that monitored the routes and reported position and stop times. The actual routes and the breakdown in tours were mapped through a detailed study of GPS information and then processed and formatted as a basis for import into the route optimization software.
All in all, three simulations were completed. The first one obtained a situation analysis that accurately reconstructs the distribution (VKT) for all driving routes and deliveries on the basis of the manually dispatched transport instructions. Based on the situation analysis, the distribution process was optimized in two scenarios. Optimization 1 has the same routes (delivery address) as the situation analysis but with an optimized sequence. Optimization 2 is based on the terms and conditions of the delivery addresses in the situation analysis but with new planning where the software algorithms are allowed to decide (optimize) which vehicle handles what delivery address and the sequence performed. The results for the situation analysis and the route-optimized scenarios have been compiled in Table 1.

Table 1. Summary of the situation analysis and simulations with route optimization.

	Situation analysis	Optimization 1	Optimization 2
Description	Routes of situation analysis, the initial transport instruction	Routes based on situation analysis, optimized sequence	Terms and conditions of situation analysis, new digital routes
(%) compared to	-	(Situation analysis)	(Situation analysis)
Deliveries	324	324	324
Routes	18	18 *(0 %)*	13 *(-28 %)*
Tours	28	28 *(0 %)*	17 *(-39 %)*
Total VKT	2 135 km	1 836 km *(-14 %)*	1 251 km *(-41 %)*
Total driving time	61 hh 53 min	57 hh 13 min *(-8 %)*	47 hh 5 min *(-24 %)*
Total working hours	126 hh 23 min	121 hh 42 min *(-4 %)*	105 hh 4 min *(-17 %)*
Average fill rate	53 %	53 %	87 % *(+34 %)*
Deliveries per route	18,00	18,00 *(0 %)*	24,92 *(+38 %)*
VKT per route	118,61 km	102,00 km *(-14 %)*	96,23 km *(-19 %)*
Driving time per route	3 hh 26 min	3 hh 11 min *(-7 %)*	3 hh 37 min *(+5 %)*
Working hh per route	7 hh 1 min	6 hh 46 min *(-4 %)*	8 hh 5 min *(+13 %)*

The situation analysis was derived from the transport instruction on the basis of the year-2011 procurement, produced with manual dispatching with 18 vehicles in static sequenced routes divided into 28 tours. The situation analysis resulted in a total of 2 135 kilometers per day, with average working hours per vehicle of 7 hours and 1 minute. This amounts to a one hour difference from the time window 9:00 a.m. to 5:00 p.m., which was agreed upon. Note that this is the time window for distribution; the first delivery takes place at 09:00 a.m. with 30 minutes added for loading in the morning as part of the simulated working time. Also note that the picking of orders and consolidation at the loading dock run until 11:00, with 10 out of 18 vehicles returning there for a second tour.

Optimization 1 alters the sequence of existing driving routes, which reduces total mileage (VKT) from 2 135 to 1 836 kilometers, or by 14 percent. The fill rate and the number of deliveries per route are the same, but VKT per route decreases by 16.61 kilometers, which means a 15 minute saving in driving time (7 percent) per route. In reality, stores will be added or removed over time, which brings constant changes to the initial transport instructions from 2011, which means there will be a negotiation between the transport buyer and transport company. In general, the transport company is commissioned to provide suggestions on how the driving routes will be rescheduled. Continuous changes mean an adjustment in the price level, which, with a business model based on a fixed price per delivery, almost exclusively means an additional cost for the transport buyer. In the case study, the transport instructions for the situation analysis were monitored in August 2014, and these terms and conditions were used in Optimizations 1 and 2.

Optimization 2 entailed a (total) replanning with the same input data (stop times) as in the situation analysis. The simulation showed that the total mileage decreases by 41 percent, from 2 135 to 1 251 kilometers, and the total working time decreased from 126 hours and 23 minutes to 105 hours and 4 minutes, or by 17 percent. The distribution could be completed with fewer vehicles, 13 instead of 18; route optimization enabled higher capacity per vehicle and increased the fill rate from 53 percent to 87 percent. When VKT decreases and the fill rate increases, each vehicle will have a larger number of deliveries per route. In the case study, the average deliveries per route increased from 18 to 24.92, or by 38 percent. It also turns out that for the VKT per route, despite five fewer vehicles, the average mileage decreased from 118.61 to 96.23 kilometers, or by 19 percent, per route.

Beginning with the fill rate, the method of the case study requires reliable (digital) documentation of load carriers, which in this case study is defined down to 0.1 per pallet location. The fill rate thus becomes a constant in calculations; in other words, the capacity per vehicle does not turn into a constraint during simulation. The fill rate of heavy vehicles represents the great "efficiency deficit" in freight transport. One of the few studies conducted in Sweden showed that the average fill rate in the distribution of food products with free delivery was 35 percent (Gebresenbet & Ljungberg, 2004). The problem is a lack of reliable (longitudinal) statistics. The estimates made have demonstrated that the fill rate is approximately 30-40 percent and rarely more than 50 percent in the Swedish freight sector (Swedish Transport Agency, 2011).

In summary, when the route optimization is applied in the procurement process, five assignments vanish. The assignments that remain should become significantly more profitable, or complete 28 percent more assignments per driving route. More deliveries in combination with a lower cost per assignment in terms of fuel, wear and tear, wages, etc., mean that profitability on a regular day increases by approximately one third for the remaining vehicles in the optimized transport flow. However, the intermediary company reduces its turnover because its fee represents a percentage of the performed transport services. A survey from the newly instituted Swedish "Freight Purchasing Panel" show that logistics costs are on average 11 percent of the product cost, and transport costs amount to approximately 6 percent on average (Lammgård et al., 2013).

5. Transport Service Purchasing Model

Firstly, it should be noted that the best timing for a transport buyer to influence the outcome of a forthcoming transport service, be it new or a rebuy, is during the procurement process. Although there is extensive literature and textbooks on procurement from a general business perspective (van Weele, 2010), there is a marked absence of research focusing on the procurement of transport services (Holten et al., 2008). However, some topics and studies with relevance to this study need to be mentioned; the need for procurement skills in small- and medium-sized enterprises (Holten et al., 2008), environmental considerations in the procurement of logistics service providers (Wolf & Seuring, 2010; Björklund, 2011), a procurement model for a municipal co-distribution of goods (Moen, 2014) and contextual variables that influence the procurement process (Rogerson et al., 2014).

Secondly, contextual variables define the conditions for a transport assignment, or, in other words, the intention of the transport buyer in the procurement process. Contextual variables consist of the purchasing situation with a new assignment or a modified rebuy; the scope of services (vehicles alone or the need for third party logistics), the degree of customization required for the service intended, the transport buyer strategy (competitive tendering or selection of a provider), and the relationship to the provider (arm's length relationships or partnerships), variables that altogether define how the intended transport service will be operated (Rogerson et al., 2014). When designing tender documents, the planned transport service can be specified and formalized based on the context in which the purchase of freight services takes place.

The proposed transport service purchasing model in this study, the Five-step model, has its contextual starting point in the relationship between stakeholders and the power of the supply chain of the intended transport service. In this regard, what is presented in its rudimentary form is an “intra-organizational” model, not to be confused with the consolidation of multiple transport buyer goods or auctioning mechanisms to improve the efficiency of freight transport services (van Duin et al., 2007). As already mentioned, an “inter-organizational” model will be possible in the future when digital data are available for all stages of the supply chain through more sophisticated methods of data capture.

The Five-step model is based on the public sector in Sweden and a new procurement model for the co-distribution of goods used in local governments, replacing the previous business model of free delivery (Moen, 2014). To review, shipments from suppliers are channeled through a freight consolidation center where the municipality has taken over the logistics function using in-house route optimization for transport planning, implicitly taking over the power of the supply chain. Follow-up is also an integrated part of the business model based on vehicle monitoring and payment with reverse billing. The transport company invoices mileage driven and the time worked, rather than a fixed price per stop, ensured by a "resource-optimized tender documents" in the procurement process.

However, the public sector has to take into account a regulatory framework, namely, the Swedish Public Procurement Act, something that a private company does not need to consider. Still there are similarities: a transport purchasing model is similar in design to a business model and outlines the process of procurement. The procurement process is generally described in three steps: define specifications, select supplier and establish a contractor agreement (van Weele, 2010). Inherent in the Five-step model is time spent beforehand, with an objective specification based on mileage, time and sequenced routes, and time spent after through follow-up linked to the payment method, which far exceeds the work performed during actual procurement with the above-mentioned three general steps (Andersson & Norrman, 2002).

It becomes an unspoken request by transport buyers that transport management and the procurement process constitute the same overall process (Holer et al., 2008). If the whole transport chain is outsourced, there is an obvious risk of lack of participation from the transport buyer side and, consequently, a lack of transparency between stakeholders, which is something that has characterized the relationship between involved parties in Sweden and, in a broader sense, Western society when transport contracts are awarded. Therefore, transport service should not be treated as an isolated management tasks; instead, it is necessary to look at the whole supply chain, with the transport procurement process being integrated to ensure increased transport efficiency (Potter, 2003).

6. The Methodology of the Five-Step Model

Starting from the municipal co-distribution of goods as a conceptual framework (Moen, 2014), a method is used based on a resource-optimized procurement process to accommodate transport buyers in the private sector, namely, the Five-Step model. The purpose of the new transport service purchasing model is for the role of the transport company (counterpart) in negotiations to become a logistics partner through transparency during the procurement and contractor agreement phases, with invoicing by reverse billing. The transport buyer achieves a procurement of transport services with increased transport efficiency at a lower cost. How does this occur? The major change in the procurement process comes down to the transport buyer only paying for the transport services used (mileage and time) and not running the risk of being over- or under-capacity, which represents "wastage" in the transport buyer’s cash flows.

In addition, an objective with route optimization is to fill the entire workday for the transport company involved to facilitate their operations (if a forwarding agent with subcontractors applies to the situation of individual transporters). It is important that the earning capacity is high enough to justify the requirements of high quality of the transport services provided. There will be an elimination of vehicles, as shown in the case study. The assignments that remain become more profitable, with a higher transport workload per route, which in the Five-step model generates more money at the transport level (individual transporters) and does not stop at the intermediary level (forwarding agent). The following section presents the five steps in the procurement process that constitutes the Five-step model, as shown in the flowchart in Fig. 1.

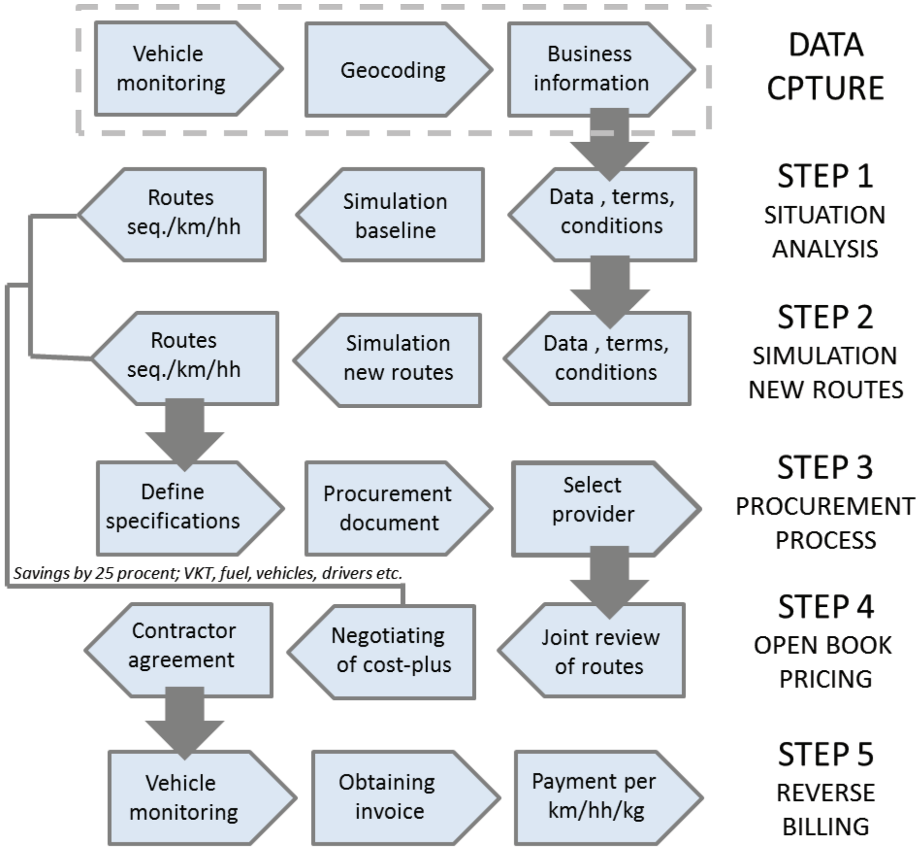

Fig. 1. Flowchart of the conceptual framework of the Five-step model.

Step 1 is based on comprehensive data capture in the preparatory phase to simulate the situation analysis of the transport flow that will be procured. A current situation is necessary to establish as a basis for measuring quality aspects and efficiency gains in a given transport flow. This process requires adequate and exact input data, an absolute prerequisite of the Five-step model. Data capture in Fig. 1 means reconstructing existing routes with vehicle monitoring (GPS) and commercial software based on vehicle routing algorithms. The process involves the existing transport company, which proves the importance of collaboration and transparency in the early stages of the procurement process to achieve the expected efficiency enhancements. Note, if procurement concerns a new transport flow, the operation must be carried out completely in the route optimization software using standardized measurements (templates) for stop times.

The aim is to obtain accurate results in kilometers and working hours and sequences of each route to calculate the cost structure per kilometer and working hour. For example, accurate stop times are most easily measured by registering when the ignition switch is turned off and on or a complete stop longer than 60 seconds, which can be measured with everything from the truck's own CAN-bus to an external vehicle computer with GPS connection or a regular smartphone with an "app". Next, follow geocoding of delivery addresses in the digital map and the collection of data with accurate stop times, integrated with predefined routes to achieve sequencing. The situation analysis is reconstructed with specified values in kilometers and hours per sequenced route, with routes reflecting the current situation.

Step 2 involves the simulation of new driving routes with the same parameters used to reconstruct the baseline in Step 1, with the same intelligent road network, geocoded delivery addresses, stop times and volumes (load carriers) of goods transported. What the computer simulations provide are new driving routes with an optimized sequence. The software algorithms strive to minimize mileage (VKT), or “deadhead driving”. The most interesting simulation becomes the cost structure, where price per kilometer and per working hour are inserted as values into the optimized driving routes in Step 2. The cost structure will illustrates in "black and white" the potential savings and efficiency gains in financial figures, compared to the same cost structure inserted in the situation analysis in Step 1.

It should be noted that not all transport flows are feasible, especially when the unconditional requirement of digital information excludes stakeholders. If digital information is lacking as a basis for the situation analysis, in simulations, or in the exchange of information between stakeholders, there is no possibility to use the Five-step model in a procurement process. In addition, certain transport flows give higher returns in transport efficiency than others. There is a volume-related constraint where a certain volume is required to achieve economies of scale by centralizing planning, which is performed with route optimization.

Step 3 is similar to a traditional procurement process but with the unconditional demands of digital input from Step 2, which define the specifications of the assignment. The actual procurement process then begins based on a resource-optimized tender document, uniformly with the procedure used in the municipal co-distribution of goods, where bids are placed on sequenced routes with specified kilometers and working hours per route (Moen, 2014). Instead of negotiating a contract through price indicators at arm’s length between parties, the contract is negotiated in collaboration among stakeholders in Step 4. The selection of a provider is based on quality aspects and the ability to connect to a digital business model that includes the transport buyer's entire supply chain.

The procurement comes down to quality aspects and to what extent tender documents specify delivery addresses, volumes, delivery terms and delivery precision, which can generate a transport planning "worthy of the name”. In general, it is up to tenderers to prepare (theoretical) routes and reach a price structure based on previous procurements and their own key figures. In that case, there is no quality-assured tender document where both parties are on the same level when negotiating. It is necessary to go through Step 1 and Step 2 because the procurement process passes directly to preparation of a quotation, the resource-optimized tender document, based on facts and negotiated in collaboration between the transport buyer and transport company.

Step 4 takes place at the negotiating table with open-book pricing. Negotiation with transparency is the most radical element of the new transport services purchasing model (Christensen, 1997). Note that negotiations take place in stages but with the transport buyer as the party that ultimately makes the decisions in the end. Open-book pricing, also termed open-book accounting, means sharing cost information with the provider involved in a contractor-client relationship, which is dependent on the purchasing strategy chosen (Agndal & Nilsson, 2010). In the context of the Five-step model, open-book pricing implies that the buyer and provider of transport services together define compensation for actual costs incurred and negotiate the margin that can be added to expenditures, also referred to as a cost-plus contract.

Traditionally the purchasing process is dominated by negotiations concerning costs, without measurable terms and conditions of the forthcoming transport services as a basis. The proposed Five-step model turns the order completely around and starts with capturing data regarding what is measurable. To define the actual expenditures, the transport buyer and the transport company both have fact sheets based on objective information, such as sequenced routes, driving time, VKT, volumes and load capacity.

Next follows a joint review of routes and specified transport workload from Step 2 with negotiation of the cost-plus, the difference in monetary values specified in Step 3 in the resource-optimized tender documents. The Five-step model reduces costs by approximately 25 percent, the difference between the output of Step 1 and Step 2, as shown in Fig. 1. The reduced amount shall be distributed, which is performed transparently in negotiating rounds between the transport buyer and transport company, with the contractor agreement determining how the cost reduction will be allocated between stakeholders. To be specific, what becomes crucial is how the 25-percent efficiency improvement is divided. The transport buyer must receive cost savings compared to the existing cost of transport services; otherwise, there is no incentive for changing the procurement process.

However, the margin of 25 percent should not go solely to the transport buyer or the intermediary company (freight forwarder), which will inevitably cannibalize its own sales. Compensation should also be delegated to subcontractors (individual transporters), which constitute the exposed part in the freight transport sector. In that respect, what the intermediary brings in added value when logistics become transparent and based on route optimization, beyond bringing financial stability and being the administrative superstructure to the deal, is brought into question.

It has been noted by Hassall & Walsh (2014) that the e-freight market takes a lower percentage of customer revenue. The individual transporter will usually gain a higher freight rate margin than operating through an intermediary company, completely in line with the findings of this study. Despite this, the intermediary level should obtain a profit share as compensation for loss of a reduced agency fee. Overall, the innovation is justified by improving the quality of transport services, cutting the transport buyer's cost base, and ultimately contributing to making the remaining assignments more profitable.

Step 5 involves follow-up and control with quality assurance for the transport services provider, and as a basis of the payment method of reverse billing. Follow-up takes place as part of the contract, which requires the transport company, or its subcontractors, to install a mobile device that provides full transparency of the information exchange. Using a CAN-bus, a vehicle computer or an "app" in a smartphone, can submit the information to all the stakeholders of the supply chain. The purpose of vehicle monitoring is to follow up and register kilometers driven and hours worked. Reports compare the result with the initially sequenced planning, determining whether deviations occur from the route and serving as a basis for reverse billing. "Reverse" is in the sense that vehicle monitoring specifies to the transport buyer what should be invoiced and deviations are checked before payment is made.

This approach is in sharp contrast to the traditional business model of the Swedish transport industry, with agreements based on either a unit price per delivery address or a fixed price per hour for an eight-hour day. In general, the intermediary company (freight forwarder) is solely responsible for logistics and transport planning, and the transport buyer cannot monitor (register) VKT or hours worked. Implicit in the business model is the transport company with its subcontractors being paid only for the hours and minutes that it takes to perform the assignment or for kilometers driven.

7. Conclusion

The reasoning behind the Five-step model is based on transparency and digital information at all stages of the supply chain, radical measures for an industry characterized by tradition and resistance to change. However, change is fundamental to increasing transport efficiency and is also highly possible, as the case study clearly shows. Digital planning provides (cost) savings in distance, time and the number of vehicles, and the fill rate increases to the same extent. These savings admittedly make vehicles redundant, but those that remain become more profitable. It must be emphasized that route optimization is available to change the business model to digital planning, but the technology is not adapted to or integrated in the Swedish transport industry. The freight service sector in particular lacks organizational innovations that can meet and accept changed behavior, due to the technical innovations already in place (Brynjolfson & McAfee, 2012). In Sweden, there has been considerable resistance to change and the use of route optimization, especially from the large and established players in the transport industry. However, the industry will inevitably be challenged by new smaller players with new business models that drive development forward, as the example in this paper show.

8. References

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